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A NEW HUMAN TREMATODE FROM JAPAN *

WILLIAM W. CORT AND SADAMU YOKOGAWA

In the last ten years the Japanese have contributed very greatly to the knowledge of the trematodes of man. Some of this work has found its way into other languages in translations and abstracts. There are, however, many important investigations on the trematodes of man in Japan which are either entirely unknown outside of Japan or are known only in very brief and inadequate abstracts. We have been working for some time on a monograph on the trematodes of man. In connection with this work one of us (Yokogawa) has brought into English the recent Japanese investigations on this group. In this connection it was surprising to discover that a new human trematode of more than incidental occurrence, *Heterophyes nocens* Onji and Nishio, which had been described in 1915 (Onji, 1915, and Onji and Nishio, 1915) was entirely unknown outside of Japan.

The work of these authors on this species gains additional importance on account of the fact that they have not only described the adult but have solved part of its life history and shown the method of infection of the human host. Their work is the first light that we have on the life history or method of entrance into the final host of any member of the genus Heterophyes. The following account of *Heterophyes nocens* is taken from the Japanese papers cited above.

In 1910, Onji, a physician in a district of the Yamaguchi province (in the southwestern part of the main island of Japan) reported before the medical society of the province that he had found a peculiar type of trematode egg in a number of fecal examinations which he had made in his district. At this time he thought that the eggs might be those of the human liver fluke. Later he came to the conclusion that he had found a new human fluke and reported his findings in 1915, including an account of an encysted larval trematode in the muscles of a fresh water fish, *Mugil cephalus,* which he thought belonged to his new adult trematode, since this fish was frequently eaten raw by the people of the district. Later in the same year, in collaboration with Nishio, he described this trematode as a new species under the name *Heterophyes nocens* and gave an account of certain stages of its life history and of its method of entrance into man.

Heterophyes nocens Onji and Nishio is found in the middle part of the small intestine of man. It is known only from two villages, Onoda and Takachiho, in the Yamaguchi province of Japan. Its eggs were found in 31 out of 168 fecal examinations made from the inhabitants of these villages. In the intestine the flukes were found between the villi and sometimes attached to the mucous membrane near the bases of the villi.

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* A contribution from the Department of Medical Zoology of the School of Hygiene and Public Health of the Johns Hopkins University.

The structure * of the adult of this species (Fig. 1) is similar to that of *Heterophyes heterophyes* (Looss) which has been known for many years as a parasite of man and other animals in Egypt. *H. nocens* is a very small trematode, having a length varying from 0.9 to 1.1 mm. and a width from 0.4 to 0.52 mm. The whole surface of the body is covered with very closely set scale-like spines. As in the other species of this genus, the genital pore is surrounded by a characteristic sucker, provided with a circle of chitinous rodlets. In *H. nocens* the number of these rodlets is about sixty. The following table shows the specific differences between *H. nocens* and the Egyptian species from man, *H. heterophyes.*

Characters	H. heterophyes	H. nocens
Size	1 to 1.7 mm. by 0.3 to 0.6 mm.	0.9 to 1.1 mm. by 0.4 to 0.52 mm.
Spines	With serrate posterior margins	Without serrate posterior margins
Oral sucker	0.09 mm.	0.08 mm.
Ventral sucker	0.23 mm.	0.20 to 0.22 mm.
Genital sucker	0.15 mm.	0.10 to 0.13 mm.
Rodlets on genital sucker	70 to 80	About 60
Intestinal ceca	Equal; end close to excretory bladder in extreme posterior of body	Unequal; one ending near anterior outer margin of posterior testis; and other close to excretory vesicle
Eggs	30 by 17 μ	28 by 15.5 μ

An examination of the table shows that these two species are distinct. *H. nocens* is smaller than *H. heterophyes.* The size of the suckers is less in the former and the genital sucker is smaller in proportion to the size of the ventral sucker. There are also differences in the number of rodlets on the genital sucker, in the character of the intestinal ceca, the eggs and the spines. Further a comparison of *H. nocens* with the analysis given by Ransom (1920) of the species of the genus Heterophyes shows that this form also differs from the species described in this genus from lower animals.

The Japanese authors have solved the question of the second intermediate host and the method of entrance into the final host of *H. nocens.* Onji and Nishio noted early in their study that the eating of raw fish, especially of the species *Mugil cephalus,* was a common habit in the two villages where *H. nocens* were endemic. Examination of this fish showed the presence of a common encysted agamodistome which they took to be the larval stage of the species they were studying. This view was substantiated by feeding experiments on experimental animals. They were in these experiments able to follow the details of development from the encysted agamodistome to the adult.

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* A more detailed account of the structure and life history of this species will be included in the monograph mentioned above.

The encysted stages (Fig. 3) were found in muscles and peritoneum of *Mugil cephalus*. The cysts are round to ellipsoidal in shape and have an average size of 0.163 by 0.136 mm. The wall of the cyst proper consists of two layers and there is a thin outer sac developed from the tissues of the host. The larvae (Fig. 4) freed from their cysts have an average size of 0.34 mm. by 0.15 mm. At this stage the ventral sucker and genital sucker are slightly back of the center of the body. The oral sucker has a diameter of 0.049 mm., the ventral sucker of 0.045 mm. and the genital sucker of 0.025 mm. It is interesting to note that at this stage the ventral sucker is distinctly smaller than the oral sucker. The pharynx has a size of 0.029 mm. by 0.026 mm. The excretory bladder is triangular in shape and filled with a mass of highly refractive concretions.

Experimental animals were infected with *H. nocens* by feeding them with fish containing these encysted larvae. The larvae grow rapidly in the final host, about doubling their size in three to four days. Eggs are present in the uterus five to six days after infection and they appear to be fully developed by seven or eight days. The reproductive organs were not distinguished by the Japanese authors in the encysted stage. They report, however, that after two or three days (Fig. 5) in the final host the testes, ovary, seminal vesicle and seminal receptacle can be distinctly distinguished and that the uterus appears as a very simply coiled tube. By three to four days the follicles of the vitellaria are clearly visible.

It seems very improbable that the two human representatives of the genus Heterophyes, *H. heterophyes* and *H. nocens*, have any injurious effects on man unless present in very large numbers. They are extremely small and apparently live more often free in the intestinal contents than attached to the wall. There is no evidence that they either break the intestinal mucosa, feed on blood or tissues, or produce a toxin. It must be borne in mind, however, that such organisms are truly parasitic and that under certain conditions of the host or when there is a very heavy infestation, they might produce injurious results. Also that a slight degree of injury to the host might be produced which would entirely escape notice.

These two species, however, have an importance to physicians working in Oriental countries since their eggs may be easily confused in

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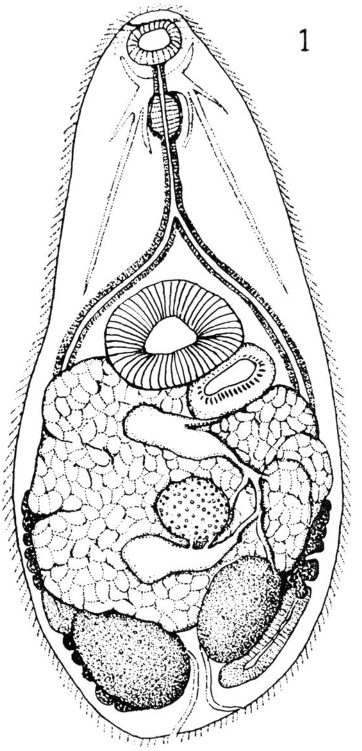

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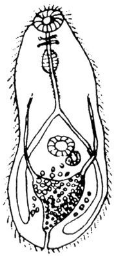

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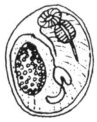

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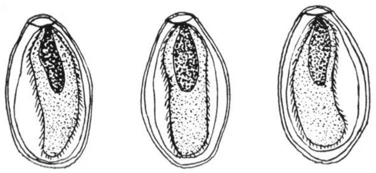

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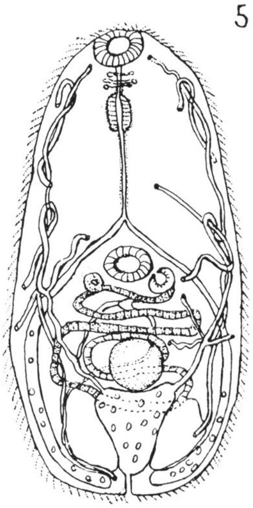

PLATE VIII

All figures concern *Heterophyes nocens.*

Fig. 1.—Adult. × 100. After Onji. Fig. 2.—Eggs. ×770. After Onji. Fig. 3.—Encysted agamodistome. × 100. After Onji and Nishio. Fig. 4.—Freed agamodistome. ×100. After Onji and Nishio. Fig. 5.—Immature stage two days after infection. × 200. After Onji and Nishio.

fecal examination with those of *Metagonimus yokogawai* Katsurada, an intestinal trematode of man in Japan, and the human liver flukes of the genus Clonorchis which have a wide distribution in the Far East. Both of these forms, especially the liver fluke, are definitely pathogenic and their accurate diagnosis is difficult except by the discovery of their eggs in the feces.

Since it is so easy to confuse the eggs of these small flukes, it is necessary whenever a small operculate egg is found in a fecal examination to study it very carefully with the high power of the microscope. With very careful examinations the eggs of *Heterophyes nocens, Metagonimus yokogawai* and Clonorchis can be accurately distinguished. The eggs of the first two species are the most difficult to separate since they have almost exactly the same size and shape. The egg of *Metagonimus yokogawai* is distincly yellowish in color and lighter than any of the other small fluke eggs. This light color is correlated with the fact that its shell is considerably thinner than that of *H. nocens* or *H. heterophyes*. Clonorchis eggs are narrowed toward the operculate end, and usually have distinct "shoulders" just back of the operculum while in the eggs of these other flukes the contour in optical section is almost regularly oval. Size differences are not reliable since the eggs are so nearly the same size and in each species there is a considerable range of variation.

Since the various species of the genus Heterophyes are not specific in their final hosts, and since as mentioned above their eggs are difficult to distinguish from other small fluke eggs, it seems probable that our present knowledge gives little real idea of their actual prevalence as human parasites. It is therefore important that medical men in regions where human flukes are found should be constantly on the lookout for these parasites. These considerations also suggest the importance of special training in medical zoology for physicians who are expecting to work in the Tropics or the Orient, where the diagnosis, treatment and control of diseases produced by animal parasites form a very important part of the routine practice.

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